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ABSTRACT

The computer has become an indispensable tool for teachers. Presently, many teachers are making efforts to master needed computer application skills. This study first focused on the differences between novice and experienced users to identify possible task-oriented factors that might help novice users overcome the learning curve. Errors frequently committed by novice and experienced users were compared. Also examined were the implementation results of several instructional devices throughout a microcomputer application course to determine the effects based on students' performance. In addition, students were surveyed for their opinions about which means they believed to be beneficial to their learning. Results suggest that practicing on integrative procedural tasks might help computer learners to perform better. The results also suggest that it is important to relate the computer tasks to the practical classroom setting and to lead undergraduate preservice students to become more aware of practicing teachers' tasks. (Author/AEF)

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ED 419 504

Paper Session

Effective Means to Help Teachers Master Computer Applications

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Abstract

The computer has become an indispensable tool for teachers. Presently, many teachers are making efforts to master needed computer application skills. The current study first focused on the differences between novice and experienced users to identify possible task-oriented factors that might help novice users overcome the learning curve. Errors frequently committed by novice and experienced users were compared. The current study also examined the implementation results of several instructional devices throughout a microcomputer application course to determine the effects based on students' performance. Students were also surveyed for their opinions about which means they believed to be beneficial to their learning.

Overview

Computer skills and knowledge are crucial for teachers to become productive and efficient. Currently, computer application courses have become widely available in various teacher preparation programs. However, many factors—unequal access to the hardware and software; diverse interests, background, and skill levels; insufficient effective learning resources; and platform differences—have discounted the computer instructor's effort and distracted the focus of proper instructional design and implementation.

There have been many studies concerning how computers interact with users during the learning of application tasks. Larner and Timberlake (1995) suggest that the major obstacle to instructional technology is negative attitudes toward technology, and the lack of expertise or experience is the major reason for such negative attitudes. Studies also support the notion that appropriate preservice and inservice training can reduce reluctance to use computers in classroom instruction (Brennan, 1991; Kolehmainen, 1992; Pina & Harris, 1993). Forcier (1996) points out that many researchers believe that one of the most effective strategies to engage teachers in acquiring the needed computer knowledge and skills is the task-oriented

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approach.

Computer Tasks and Instructional Enhancements

The task-oriented approach and hands-on activities have played an important part in computer application courses. However, simply having teachers conduct computer tasks does not necessarily help them master the needed skills and cope with the learning curve. With many years of experience in teaching computer applications to teachers, the author finds that there are various kinds of tasks and that some tasks are more problematic than others for certain users. These tasks may be organized into three knowledge categories. Also, several innovative instructional enhancements may be designed and developed to help teachers smoothly climb up to the desired knowledge and skill levels. These tasks and enhancements are described as in the following section.

Computer Task Categories

Conceptual knowledge. Conceptual knowledge concerns basic computer operational concepts, including how computers process information and how software operates. The following are some examples of conceptual knowledge.

- To close a document is not the same as to quit a program.
- To copy a selected range of information or data, the computer stores the information in the available memory. The size of data to be copied is limited by the size of the computer's memory.
- To format a disk is to prepare the disk for use. We don't have to format the same disk each time when we use it. The formatting process will erase the entire information on the disk.
- To include text as well as graphics elements in a certain word-processing programs, users might have to switch between the text mode and the graphics mode. The graphics inserted in the text mode will become in-line graphics that will be treated as if they were text characters.
- To enable printers to print properly, users have to specify the correct printer setup, especially if more than one printer is connected to the computer.
- To copy or delete data, users first need to select the intended data. Otherwise, the computer will not understand what to do with the given copy or delete command.

Declarative knowledge. Declarative knowledge refers to functions, features, technical terms, and their meanings. The following are some common computer terms that belong to the declarative knowledge category.

- Icon bar and ruler
- Justification
- Header and footer
- Copy, cut, and paste
- Widow or orphan

- Macro or shortcuts
- Style sheet
- Cell references
- Web browser

Procedural knowledge. Procedural knowledge refers to the intellectual steps needed to accomplish a given integrative task or to troubleshoot problems in a complex setting. The following tasks require procedural knowledge.

- Organize a newsletter
- Create a slideshow
- Customize a business card
- Make a calendar
- Develop a gradebook
- Correct some formatting errors by using the search-and-replace function
- Simplify repetitive tasks with macro functions
- Configure speech and sound for the computer system
- Convert data files with different formats

Although these task knowledge categories are fundamentally different, it is sometimes difficult to distinguish one category from another. Very often a task may require background knowledge and skills from more than one knowledge category. Anderson (1985) suggested that procedural knowledge must pass through the declarative knowledge stage. Smith and Ragan (1993) pointed out that in many cases conceptual and declarative knowledge is essential to learning intellectual skills. To enhance current computer application courses, investigations on the relationship between the types of tasks and the users' learning performances are indispensable.

Instructional Enhancement Devices

To help teachers smoothly and effectively master the intended tasks, a few instructional enhancements were designed and developed for this study. They included:

- Detailed, step-by-step information for the task.
- General information and terminology.
- Review of related tasks and features to the real-life experience.
- Quizzes functioning as formative evaluations. Quizzes are in the format of standardized tests and online computer tasks.
- Team projects.
- Model work samples/students' work sharing.
- Different types of exercises.
- Follow-along exercises provided during in-class demonstrations.
- Mock-up exercises used after class to reinforce the skills learned.
- Creative exercises (or open-ended miniprojects) given after class.
- Think-through exercises employed to engage teachers to think and to establish a whole picture of the tasks accomplished.
- Challenge exercises provided to invoke deep thinking and application. For example, teachers were asked to reverse procedures they had learned about

spreadsheet and charting, i.e., to develop a set of data based on a given chart. They were then encouraged to think about how they could use this approach to engage their students to think critically and creatively.

Purpose of the Study

The goals of this study were to gain information about the following issues:

- How do novice computer-using teachers differ from experienced computer-using teachers?
- How do inservice teachers differ from preservice teachers in computer learning?
- What kinds of devices can help novice users master computer tasks and accelerate the learning curve?

Method

Subjects

This study is based on a college-wide microcomputer application course with 36 undergraduate preservice teachers and 42 graduate inservice teachers.

Instruments

To assess students' performance, the following instruments were developed and employed:

- *Error log*. Students were asked to keep a weekly log and to report the errors they made.
- *Written quiz*. Quiz items were used to assess if students had acquired needed conceptual and declarative knowledge.
- *Final portfolio*. Students were encouraged to develop an integrative portfolio to demonstrate what they had accomplished in the course in terms of tasks reflecting teachers' needs in a real classroom setting. They were allowed to focus on tasks related to either teacher's productivity or instructional enrichments or both. The grade for the portfolio was based on student efforts, thoughtfulness of the tasks, original ideas, creativity, and levels of difficulty. The final portfolio was used to assess intellectual procedural knowledge.
- *Exercises*. Five types of exercises were implemented at different stages as needed to help consolidate students' learning experience.
- *Survey*. Students were surveyed at the end of the semester regarding the ways in which they felt the instructional enhancement devices had helped them.
- *Final interview*. The author interviewed two students from each group at the end of the semester to acquire their feedback on the course.

Procedure

Students (including all inservice and preservice teachers) started the course and rated their own computer experience and skill levels. All the students were taught in depth about the ClarisWorks and Netscape programs and were asked to work on exercises, miniprojects, and final portfolios. As the course went on, students reported on the errors they made and how much time they had spent on which tasks. Data collected also included students' quiz scores and final portfolio grades. At the end of the course, students were surveyed for their opinions about the effectiveness of the instructional enhancement devices. Two students from each group were also interviewed to provide extra information and feedback to this study. All the data collected were analyzed to address the abovementioned research issues.

Choice of the Programs

The ClarisWorks and the Netscape Navigator programs were used as the primary tools for this study because of the following considerations. Both programs were available for various platforms and were readily installed in the computer lab. In addition, both programs were considered feasible to meet teachers' computer needs. Using Netscape Navigator to browse the World Wide Web has been a popular practice so that it was though this might increase teachers' willingness to try their best for the exercises. ClarisWorks had been a popular integrated program used in the school. It can be used for a wide range of tasks that address the needs in almost every aspect of teachers' work.

Results

Student's Self-Reported Computer Experience and Skill Levels

Students were asked to rate their own computer experiences and skill levels. Based on such information, they were categorized into four groups—preservice novice (PN = 22%), preservice experienced (PE = 24%), inservice novice (IN = 40%) and inservice experienced (IE = 14%), as shown in Table 1. Some students had prior experience in using ClarisWorks and Netscape, but their experiences were not extensive enough to affect the tasks to be learned and accomplished.

Table 1. Self-rated as novice and experienced users

Computer experience	Preservice (Undergraduate)		Inservice (Graduate)	
Novice	17	22%	31	40%
Experienced	19	24%	11	14%

Error Analysis of the Computer Tasks

From what students reported about the errors they made in the computer tasks, it is obvious that novice users seemed to make more mistakes in all the categories than

the experienced users. The gap between inservice novice and experienced users, as shown in Table 2, is significantly bigger than the gap between preservice novice and experienced users.

Table 2. Frequency of errors made for each knowledge category as reported by students

	Conceptual Knowledge		Declarative Knowledge		Procedural Knowledge	
	Total	Average	Total	Average	Total	A
PN (n = 17)	54	3.18	73	4.29	75	4.
PE (n = 19)	25	1.47	38	2.24	35	2.
IN (n = 31)	67	3.94	89	5.24	80	4.
IE (n = 11)	9	0.53	18	1.06	15	0.
Total Novice (n = 48)	121	7.12	162	9.53	155	9.
Total Experienced (n = 32)	34	2.00	56	3.29	50	2.

Note: PN: Preservice novice PE: Preservice experienced
IN: Inservice novice IE: Inservice experienced

Student Choices in the Miniproject Exercises

Students were allowed to choose miniprojects for the creative exercises. Although they were encouraged to try the integrative tasks, many students chose to work on simple tasks, something like the mock-up examples provided in class demonstrations. As shown in Table 3, those who chose to do the integrative tasks performed better than those who did not. It is likely that those who chose to do the basic tasks did not feel comfortable or ready to do the integrative tasks. The fact that only a low number of novice users chose to do integrative tasks may have supported this concern. However, the fact that those novice users who dared to try out the integrative tasks performed exceedingly well in their final portfolio probably suggests that integrative tasks might help computer learners accomplish more.

Table 3. Practice on advanced exercise and performance

	Mean Quiz Scores	Mean score for portfolio grade
Novice (n = 48)	70.06	80.50
Basic tasks (n = 42)	69.35	79.21
Integrative tasks (n = 6)	75.00	89.50
Experienced (n = 30)	93.10	84.40
Basic tasks (n = 10)	89.30	76.20
Integrative tasks (n = 20)	95.00	88.50

As shown in Table 4, undergraduate preservice teachers seemed to have better basic skills and did well on the quizzes. However, the preservice teachers did not perform as well as the graduate inservice teachers who had more experience in the public school classroom and had better ideas of how to apply what they had learned to the portfolio tasks.

Table 4. Mean quiz scores and portfolio grades between preservice and inservice teachers

	Quiz	Portfolio
Preservice (n = 36)	87	75
Inservice (n = 42)	72	88

Students' Perceptions About the Usefulness of the Enhancement Devices

Based on a 5-point scale survey (with 5 equaling strongly agree and 1 equaling strongly disagree), students were asked to rate the enhancement devices as to their helpfulness in computer learning. The mean scores in Table 5 show that experienced users and novice users significantly disagreed on item 1, 2, 7a, and 7b, where novice users appreciated more information and simple, easy-to-follow tasks.

Table 5. Mean scores of the helpfulness of the enhancement devices to learning

Type of enhancement device	Experienced users	No
1. Detailed, step-by-step information for the task	3.5	4.7
2. General information and terminology	3.0	4.6
3. Review and relate tasks and features to real-life experience	4.0	4.5
4. Quizzes	4.0	4.2
5. Team project	3.5	4.5
6. Model work samples/group sharing	4.1	4.9
7. Exercises		
a. Mock-up exercise	3.3	4.8
b. Follow-along exercise	2.7	4.9
c. Creative exercise (open-ended project)	4.0	4.2
d. Thinking-through exercise	4.4	4.9
e. Challenge exercise	4.7	4.0

Time spent on exercise activities is a widely recognized factor in the successful accomplishment of almost any learning task. The results in Table 6 showed that those students who spent more time on the computer tasks performed better on both quizzes and the final portfolio than those who spent less time.

Table 6. Average time spent and the mean quiz scores and mean portfolio grades

Time spent (in minutes)	Mean Quiz Scores	Mean Portfolio Grades
< 30 (n = 11)	70	72
30-60 (n = 24)	68	69
60-90 (n = 35)	86	91
90-120 (n = 6)	90	96
>120 (n = 2)	95	98

Other Factors

From the interview of two students from each group, the author gathered more feedback from students about what could help them learn better. Their responses included the following:

- *Prior teaching experience is very important*. Several preservice teachers voiced their concerns that they had no ideas about what kinds of teacher tasks they could do with computers. Such concerns were not an issue for the

inservice teachers. This would explain why most preservice teachers had better conceptual and declarative knowledge (as shown in their quiz scores) but did not perform as well as the inservice teachers on the final portfolio.

- *Computer access is essential*. Because both Netscape Navigator and ClarisWorks are available across the platform, a few teachers expressed their appreciation that they would be able to practice at home. Two teachers bought new computers after they took this course because they sensed that easy access would make a greater difference for their learning.
- *Don't be afraid to try something out*. To accomplish the more complicated integrative tasks, users need to possess good conceptual, declarative, and procedural knowledge. However, experienced users differ from the novice users not just in the knowledge and skills they have but also in the way they explore computer programs. Experienced computer users seem very flexible in trying out new programs and locating solutions to the challenges, whereas the novice users are mostly hesitant to try.
- *The thinking-through process is important*. Thinking-through exercises may help students develop an ability to synthesize the information they have learned in order to develop more complex integrative tasks. A few novice students were not able to accomplish the given tasks and asked for help. When the tasks were analyzed and broken into smaller pieces, these students could handle individual tasks separately without problems. After the thinking-through exercises, they understood the concepts and were able to accomplish the given tasks. The thinking-through exercise helped students master tasks and gain confidence.

Conclusion

Technology offers teachers the opportunity to become efficient at work and to conduct effective instruction. Task-oriented approaches to engage teachers in active learning about computer applications are necessary but not sufficient. Teachers should acquire conceptual and declarative knowledge as well as the procedural knowledge described in this paper. The current study examined information about computer users' behavior and the type of tasks. Novice users needed to work on all types of tasks to improve their knowledge and skill levels.

To master computer applications, users should spend sufficient time on meaningful integrative tasks. The results suggest that practicing on integrative procedural tasks might help computer learners to perform better. The results also suggest that it is important to relate the computer tasks to the practical classroom setting and to lead undergraduate preservice students to become more aware of practicing teachers' tasks.

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